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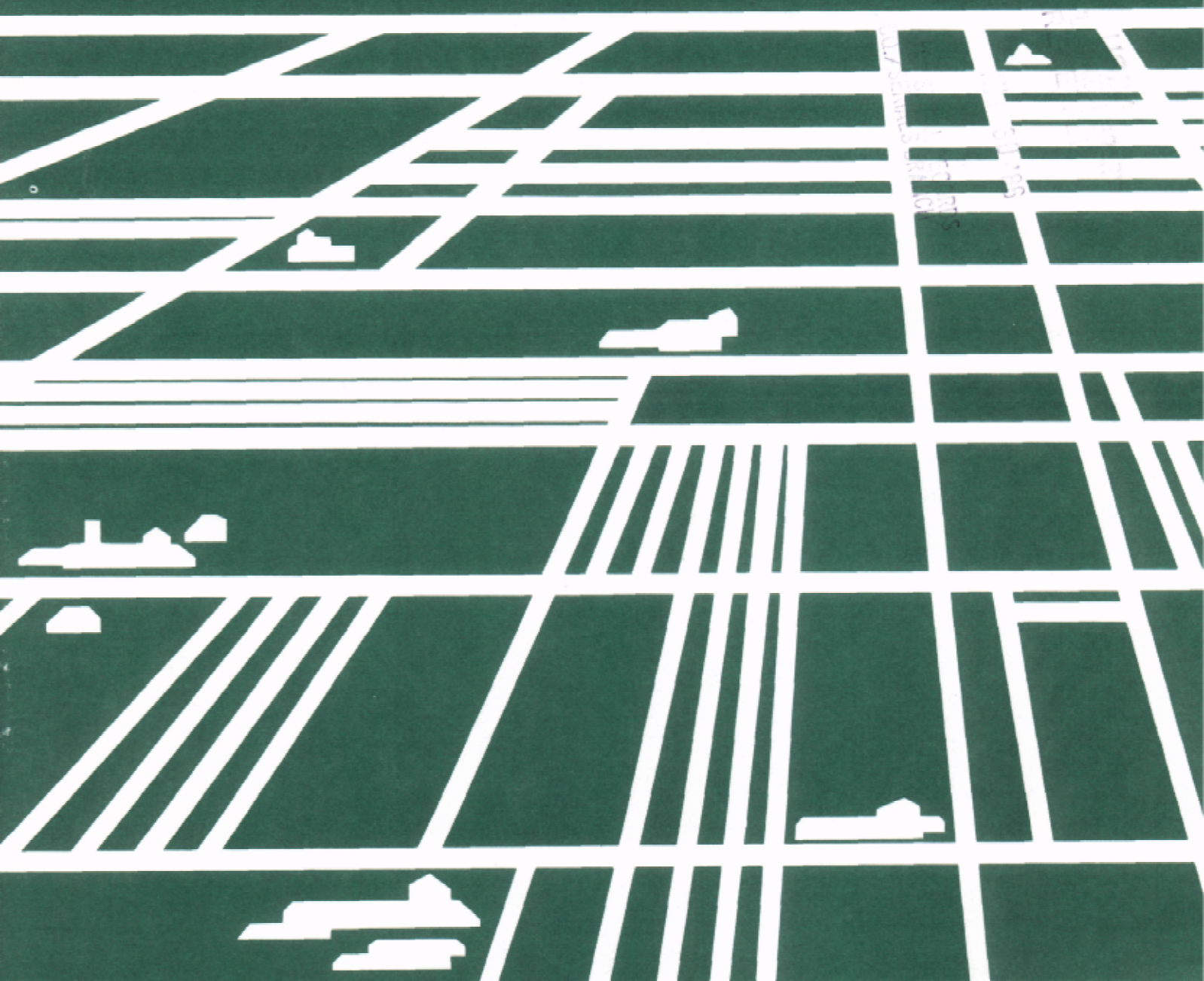
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Cropland Rental and Soil Conservation in the United States

Nelson L. Bills



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Abstract

Data from USDA's Resource Economics Survey challenge the common, but not well-substantiated, view that farmers are less concerned with erosion on land they rent than on land they own. At the national level, farmers' conservation efforts—as reflected in crop rotation, tillage practices, and use of conservation practices—on rented cropland compare favorably with those on owner-operated cropland. Nevertheless, rented land is subject to more erosion because a greater proportion of it is used to produce erosive row crops.

Keywords: Soil erosion, landownership, conservation management

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Summary

New evidence, presented here, challenges the conventional view that farmers are more concerned about erosion on land they own than on land they rent. That conclusion stems from an analysis of landownership data from the USDA's Resource Economics Survey. Major findings are:

- The erosion potential of land leased by farmers is comparable with that of land owned by farmers. Thus, at the national level, greater soil loss should not be expected on rented land if farmers plant similar crops and devote similar effort to conserve soil through crop rotation, tillage practices, and conservation support practices.
- Cropping patterns are materially different. Nearly two-thirds of leased land is used for erosive row crops, compared with about half the owner-operated land. The difference is principally due to greater acreages of hay and pasture (least erosive crops) on owned land.
- Conservation management, which includes crop rotation, tillage practices, crop residue management, and conservation support practices (such as terraces or contour farming), on rented land compares favorably with that on owned land. While management on rented land may be substandard in some situations, national data do not support the hypothesis that farmers neglect land they rent.

These findings do not support arguments that leased cropland should be treated differently from owned cropland in the design of public soil conservation policy. High soil loss erosion rates, for the most part, arise from two factors: the use of some highly erosive land for crop production, and the production of erosive row crops on large amounts of cropland. Producers farming leased land or land they own are caught up in these general features of U.S. farming.

If the trend toward increased dependence on leased land continues, the Nation's soil loss problem may worsen because of the greater proportion of leased land in row crops. With current technology, these crops lead to high rates of soil loss if grown on land susceptible to rainfall erosion.

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Introduction

Crop production causes some land to erode at rates that may adversely affect its long-term productivity and impair water quality. A persistent concern, dating to the early 1900's, has been that farm tenancy tends to accelerate soil loss from cropland (11, 19, 21).¹ This stems from the view that farmers give better conservation treatment to land they own. Although recent studies dealing with the impact of land tenure on soil conservation do not always support these long-held views (6, 14), popular opinion often stresses the importance of land rental as an impediment to erosion control. In a 1982 survey covering 15 States, for example, 44 percent of those interviewed believed that farmers were more concerned about erosion on their own land than on land they rented (12).

This publication uses new quantitative evidence on cropland ownership and rainfall erosion to compare conservation management on land farmed by the owner and land farmed by a renter. I arranged the evidence to compare three factors:

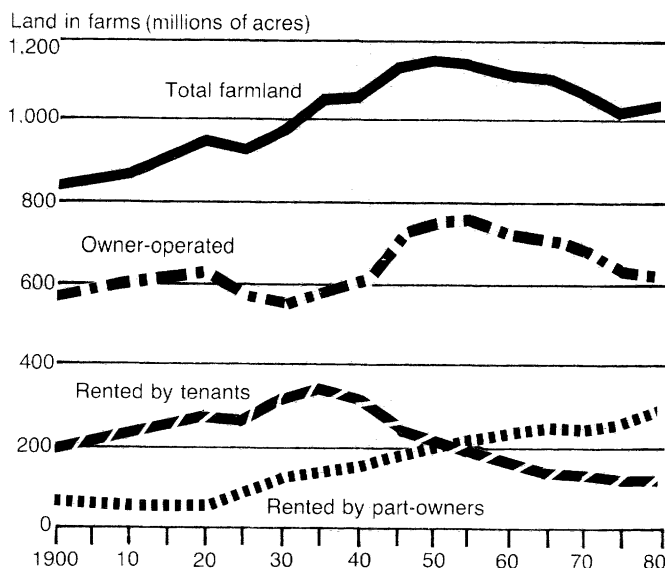
- Whether rented land, because of its physical characteristics, is more susceptible to rainfall erosion.
- Whether relatively more rented land is used to produce erosive crops.
- Whether rented land receives inferior conservation treatment.

The land rental/soil loss issue has a direct bearing on discussions about public erosion control policies and programs. Although farm tenancy—a type of farm where the farmer rents all land operated—has declined since the midthirties, the amount of land controlled

through rental has ranged from 35 to 40 percent since 1950 (fig. 1). This trend, combined with the fact that many landlords are absentee or have no direct familiarity with farming, may present vexing problems to USDA agencies responsible for technical and financial assistance for erosion control (10, 3). USDA programs focus upon farm owner-operators for the most part. If farmers use more abusive farming practices on land they rent, then public programs will need to be redesigned to intensify conservation effort on rented land.

On the other hand, specific efforts to tailor conservation policy to rented land are unnecessary if farmers tend to manage their leased land much like their own land. This report clarifies the conservation/rented land issue by contrasting the economic incentives to deplete

Figure 1. Owned and rented land in farms, United States, 1900–1978



Source: (26).

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¹Italicized numbers in parentheses refer to items cited in References at the end of this publication.

soil on owned and rented land. National data from USDA's Resource Economics Survey (see box) are arranged in a fashion to allow one to test for statistical differences in conservation management on owned land and rented land. Conservation management, for the purposes of this study, is measured quantitatively and reflects the cumulative effect on the land management practices—such as crop rotations and tillage operations—and such conservation support practices as strip-cropping, terraces, and contour farming.

Theory of Land Rental and Soil Loss

The idea that a farmer operating owned land is more inclined to conserve soil than a farmer who rents land is well rooted in economic theory. Theoretically, farmland is used to maximize the present value of annual net returns from crop and livestock production and the value of the land asset at the end of a planning period. Thus, soil loss is tolerated by a farm operator to the point where the marginal value of soil lost is greater than or equal to the profits foregone when soil is conserved (17). This familiar notion of profit maximization makes the attitude of the farm operator toward soil conservation a function of (a) length of planning horizon, (b) the discount rate, (c) effects of soil loss on

the income stream from production, and (d) effects of soil loss on the terminal value of the land asset. One expects the amount of soil conserved to be positively related to the length of planning horizon and inversely related to the discount rate. Decreases in annual net income or diminutions in the terminal value of the land attributed to soil loss provide economic incentives to undertake soil conservation measures.

From such a theoretical perspective, one can argue that operation by a tenant will induce more soil loss than operation by an owner. A renter has little incentive to incorporate erosion-induced changes in the terminal value of the land into decisions on land use. Renters ignore these changes in capital value because they accrue to the landlord. The owner enjoys any capital increases due to conserving soil and, conversely, suffers any capital loss due to soil depletion. A renter is interested in conserving soil only to the extent that the annual net income stream is affected. If soil loss does not affect net income, one expects a renter to ignore it. The owner-operator is less tolerant of soil loss because it may reduce the terminal value of the land.

The theoretical case for greater soil erosion for land operated by a renter does not rule out conservation measures on rented land. Such measures may be taken

Sources of Data

The study is based on land use and landownership data from the U.S. Department of Agriculture's Resource Economics Survey, a 12-part package of interrelated information on the ownership and use of land resources in the 48 conterminous States and Hawaii.

The first part of the package, the Soil Conservation Service's (SCS) 1977 National Resource Inventory (NRI), provided data on the use and quality of the land. The second part, the 1978 Landownership Survey (LOS), provided information on landowners.

The 1978 LOS was linked to the 1977 NRI (16). The NRI was based on a point sample of the U.S. land area, stratified on the basis of land units that were generally 160 acres in size. Soil Conservation Service field technicians collected data on each of three randomly selected points in each of the 70,000 sampled land units.

To accomplish the LOS, field technicians obtained the name and address of the owner of the first

sample point in each land unit. About 12,000 of the 70,000 points fell on land owned by units of government or on land held in trust for Indian tribes. These owners were eliminated from the LOS so that the survey could be confined to privately owned land.

Private owners were contacted with a mail questionnaire. A first and second mailing, selected personal interviews, and a telephone followup on those who did not respond ultimately yielded usable data from about 37,000 private landowners. Thus, the survey covered 65 percent of all sample points known to be privately owned. Each respondent reported on all land owned in his (her) county of residence.

Land use and landownership data from the NRI and LOS were merged for this study. The study was confined to NRI sample points that (a) were in row crops, close-grown field crops, rotation hay or pasture, improved hayland, or other cropland not harvested or pastured and (b) could be identified as owner-operated or rented. A total of 9,933 sample points (77 percent of all cropland sample points in the LOS-NRI merged file) met these two criteria.

to maintain or enhance annual net income from agricultural production. However, several institutional considerations are thought to impede conservation treatment on rented land. First, tenure insecurity stemming from a short-term lease—and hence, a short planning horizon—can serve as an obstacle to long-term conservation practices. Renters may be inclined to make few improvements to land if the benefits will accrue to another party (5, 27). Also, incentives to work jointly with one's landlord to conserve soil can be impeded by flaws in lease terms (5, 27). Conservation improvements are more likely if leases ensure that improvement costs are borne by each party in proportion to the benefits received.

Second, the use of conservation measures may be impaired by a lack of information on erosion problems and uncertainty about the effects of erosion control practices on cropland productivity. Impediments of this sort might be more severe on rented land if the landlord is an absentee or is unfamiliar with the details of the farming operations.

Comparing Conservation Effort on Owned and Rented Land

The theoretical case for less conservation effort and, hence, accelerated soil loss on rented land seems persuasive. This helps explain, perhaps, the preoccupation with land rental as a factor in inadequate conservation management on cropland. For example, USDA's authoritative 1938 Yearbook of Agriculture identified farm tenancy as a key institutional factor leading to excessive soil loss from cropland (27). Since quantitative estimates of cropland soil loss were not available at that time, evidence presented in support of this thesis was based on the increasing incidence of tenancy since the turn of the century (see fig. 1) and Census tabulations showing the tendency for tenant farmers to keep less pasture for livestock and to specialize in the production of erosive row crops. The yearbook asserted, based on these data, that one could confirm "... the tendency for farming under lease to be of a soil-depleting type" (27, p. 152).

U.S. agriculture has changed a good deal since the thirties. Yet, more contemporary studies provide only fragmentary and often conflicting evidence on the role of land tenure in soil erosion. Ervin studied erosion rates on 120 farms in a single Missouri watershed and found average soil loss rates to be significantly higher on rented cropland than on cropland operated by an owner-operator (9). By indexing the physical erosion

potential of cropland, Ervin concluded that the rented land included in the study was less vulnerable to rainfall erosion than land operated by an owner. Considered together, the finding that renters generate higher soil loss even though they farmed less erosive land lends considerable support to the hypothesis that relatively more abusive farming practices are carried out on rented cropland.

These findings, while highly suggestive, represent a situation in a single locality and may not support policy decisions made at the regional or national level. Such evidence is now available in the USDA's Resource Economics Survey. Lee (13) assigned Survey respondents to three tenure classes—full-owner operator, part-owner operator, and landlord—and compared average rates of erosion on sample points identified as cropland in the NRI. She found no significant differences in erosion rates among the tenure classes. Lee and Stewart (15), using the same tenure classes, analyzed NRI cropland sample points with conservation tillage. They concluded that, both regionally and nationally, farm tenure does not affect adoption of this soil-conserving practice. Slightly lower rates of adoption were found for full owner-operators, but this was attributed to smaller farm size for farmers who do not supplement owned land with land rented from others.

Baron (2) analyzed investments in conservation structures by farm tenure. He concluded that farmers who own all or part of their land are more likely to invest in soil-conserving land improvements; share leasing, as opposed to cash leasing, was also positively associated with such expenditures. Only ownership data were used in Baron's study, and consequently, relationships between investments in conservation structures and the status of soil loss on the land were not taken into account.

Unfortunately, one encounters several problems in interpreting these studies in light of national concerns about conservation effort on rented land. First, preoccupation with tenure classes muddles the critical distinction between cropland used by an owner and cropland used by a renter. While owner operation and tenant operation is unambiguous for full-owner operator and landlord categories, some part-owner operators are also landlords. Since the LOS refers to the owner's total holdings, cropland management, recorded for a sample point in the NRI, cannot be unequivocally associated with operation by an owner or a tenant. The sample point may have fallen on a land parcel used by the owner-operator or on a land parcel that one farmer leases to another.

Second, the connection between soil conservation measures, whether structural improvements to land or the use of a certain tillage practice, and an acceptable rate of soil loss is not clear. A recent study has shown that, at the national level, there is no demonstrable relationship between the presence of such conservation measures and the potential of land so treated to erode above a commonly accepted soil loss tolerance of 5 tons per acre per year (4). The evidence suggests that conservation measures have often been applied to cropland with low susceptibility to erosion from rainfall.

Even when erosive land was involved, analyses focused on conservation structures or tillage practices have been piecemeal and gave little indication of the overall impact on soil loss. Annual soil loss depends on the joint effects of crop rotation, tillage practices, and conservation support practices. Use of conservation support practices such as a grassed waterway or a terrace may have little impact on soil loss if the land so protected is used intensively for the production of a highly erosive crop. Unless all factors governing soil loss are taken into account, one's view of the degree of conservation management will be distorted.

A preferable approach is to measure conservation management after controlling for cropland erosivity—the physical susceptibility of land to erosion from rainfall—and the crop enterprise on the land. That was done in this study by classifying U.S. cropland according to its erosion potential and classifying the crop grown in 1977 according to its erosiveness. Then, differences in conservation management on owner-operated and rented land were analyzed by comparing vegetative cover and management factors and conservation support practices as reflected in the Universal Soil Loss Equation (USLE).

As stated above, rates of annual soil loss or the presence of conservation support practices on cropland are not satisfactory measures of effort. Definitive measurement must take the cumulative effect of all management factors that govern soil loss into account. These include crop enterprise, crop rotation, crop tillage, and the presence or absence of conservation support measures.

Such management factors are reflected in the Universal Soil Loss Equation, an erosion model designed to predict average annual soil losses in runoff from specific field areas in specified cropping and management systems (25). Only sheet and rill erosion from rainfall is predicted by the USLE. It does not account

for soil loss from gullying, road banks, stream banks, or wind.²

The USLE takes the form:

$$A = RK(LS)CP$$

where: A = computed average annual soil loss per unit area, usually expressed as tons per acre per year;

R = the rainfall and runoff factor accounting for the number of rainfall erosion index units occurring in the average year;

K = the soil erodibility factor, measuring the soil loss rate per erosion index unit for the specific soil;

LS = the topographic factor, accounting for the effects of slope steepness and length, relative to a 9-percent, 72.6-foot reference slope;

C = the cover and management factor, accounting for the specified crop and management relative to tilled continuous fallow;

P = the support practice factor, accounting for the effects of contour plowing, strip-cropping or terracing relative to straight-row farming up and down the slope.

The USLE can be partitioned into physical and managerial components of soil loss. If a field is in continuous clean-tilled fallow, the average annual soil loss equals the product RKLS (25). This product can be thought of as a reference soil loss which is neutral toward management. RKLS is a quantitative measure of the land's physical erosion potential (4, 9).

The product CP reflects the kind of management applied to the land with a theoretical range from zero to one. The amount of erosion increases as CP increases; the maximum CP observed in the 1977 NRI was 0.7. CP is a quantitative measure of management as it affects

²Wind causes significant amounts of cropland erosion, but comprehensive estimates of soil loss from this source are not available from the 1977 NRI. Summary data from the 1982 NRI indicate that wind displaces about 1.2 billion tons of soil from U.S. cropland each year (23).

soil erosion.³ It avoids the confusion caused by using annual soil loss (USLE) as a point of reference for conservation effort because erosion potential of the land (RKLS) can be taken into account.

Procedures

USDA data files, based on the merger of records from the 1977 National Resource Inventory and the 1978 Landownership Survey, were used to examine differences in rainfall erosion on owner-operated and rented land. Several steps were taken to fashion a strict comparison of management on owned-operated and rented cropland.

³In some cases, management affects the physical constraints on soil loss. For example, the principal effect of terraces and diversions on soil loss is a change in slope length. Once such an improvement is made, however, slope length is altered permanently or until the improvement is destroyed.

For More Information . . .

Classifying soils by partitioning the Universal Soil Loss Equation into physical and managerial components adds precision to analyses of land management decisions as they relate to rainfall erosion. This approach identifies soils that can or cannot meet a specified annual soil loss tolerance, taking into consideration the management used on the land. Different techniques, involving the SCS land capability class and subclass system, identify only soils for which erosion is the dominant limitation.

Research incorporating this taxonomy of cropland erosivity is discussed in a recent publication by the U.S. Department of Agriculture. **Assessing Erosion on U.S. Cropland** demonstrates that more than one-third of U.S. cropland is inherently nonerosive. More than 234 million acres (55 percent) is moderately erosive and requires conservation management to keep erosion within a 5-ton-per-acre-per-year soil loss tolerance. During the 1977 crop year, management practices on 63 million acres of this moderately erosive land resulted in soil loss above tolerance. The remaining cropland (8 percent) is inherently erosive and requires permanent vegetative cover to achieve tolerance.

Assessing Erosion on U.S. Cropland: Land Management and Physical Features is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. GPO stock no.: 001-019-00341-3. Price: \$1.50. Make checks payable to Superintendent of Documents.

First, classification of landowners based on farm tenure was abandoned. Tenure classes, uniformly used in previous studies, obscure relationships between cropland management and ownership. The obscurity is a result of the point sample method used in the 1977 NRI and the mail survey method used in the LOS. An NRI sample point cannot be assigned to a tenure class when an owner operates some land as a farm and rents some land to another—the point may have fallen on owner-operated land or rented land.

Second, measures were taken to examine cropland management while controlling for differences in the inherent erosivity of the land. As in an earlier study (see box), cropland was assigned to one of three erosion classes. Each class discriminates cropland based upon RKLS, the physical parameters governing annual soil loss rate, and a 5-ton-per-acre-per-year soil loss tolerance (table 1). Nonerosive cropland cannot erode at an annual rate greater than 5 tons regardless of the management applied. Highly erosive cropland cannot be managed to a 5-ton tolerance except under the most restrictive management (a CP combination under 0.1, usually associated with a permanent sod cover). The residual—labeled moderately erosive—erodes above or below 5 tons per acre per year depending on the cropping and conservation support practices used by the farm operator.

Finally, measures were taken to fashion a more incisive examination of conservation management on owned and rented land. The USLE shows that soil loss is predicted on RKLS, the inherent erosivity of the land; management, as reflected in CP, is a moderating influence and allows quantitative measures of the role land management plays in soil loss. However, CP measures both crop enterprise and conservation treatment. Traditional conservation practices such as strip-cropping and contour farming are reflected in the support practice (P) factor of the USLE. Some of these support practices imply a modification in crop enterprise, but others do not. Strip-cropping, for example, implies the production of crops in rotation while several other conservation support practices are not inconsistent with continuous cropping.

Table 1—Taxonomy of cropland erosivity

Erosion class	Definition
Nonerosive	$RKLS \leq 7$
Moderately erosive	$7 < RKLS < 50$
Highly erosive	$RKLS \geq 50; USLE > 5$

Source: (4).

The USLE cannot be manipulated to clarify the relation between conservation management and the operator's selection of a crop or a crop rotation because several well-recognized techniques for reducing soil loss from rainfall are measured by the C factor rather than the support practice (P) factor. The C factor reflects not only selection of a crop enterprise(s) but also the use of cover crops, management of crop residues, selection of tillage equipment, and timing of tillage operations. These techniques, quite correctly, are also referred to as conservation practices. As before, these practices are consistent with a number of crop rotations; the USLE cannot be manipulated to find the relation between their use and an operator's selection of a crop (or a crop rotation).

On average, the erosion-reducing effects of vegetative cover and management (C factor) appear to be more important than traditional conservation practices (P factor). For cropland planted to row crops and small grains, a recent analysis of NRI data shows that, on average, the C factor reduced actual erosion to 30 percent of potential erosion; the P factor reduced erosion to only 95 percent of the rate that would have resulted from cover and management practices alone (7).

For this study, it was useful to make a distinction between selection of crop enterprise and the use of soil conservation practices. The distinction was made by examining conservation management, as reflected in CP, after controlling for erosiveness of the crop grown. Ideally, one should control for the crop sequence or rotation, but such information is not available in the NRI.

Following a classification suggested by Osteen (18), crops grown in 1977, as identified in the 1977 National Resource Inventory, were assigned to one of four crop erosivity classes (table 2). Row crops are highly or moderately erosive; highly erosive row crops have relatively smaller amounts of soil-conserving, post-harvest plant residues than moderately erosive crops.

Table 2—Taxonomy of crop erosivity

Erosion class	Definition
Least erosive	Rotation hay and pasture, improved hayland, native hay, other cropland
Less erosive	Wheat, barley, oats, rice, other close-grown crops
Moderately erosive	Corn, grain sorghum, other row crops
Highly erosive	Soybeans, cotton, peanuts, tobacco, sugar beets, potatoes, vegetables

Close-grown crops are less erosive; hay crops and all other (and presumably idle) cropland are least erosive.

The logic used to partition the USLE into its physical and management components and account for the erosiveness of the crops grown suggests three testable hypotheses regarding soil erosion on rented compared with owner-operated cropland. Each hypothesis seems important in connection with the design of public policies for soil conservation. They are:

Hypothesis 1—Renters used relatively more moderately or highly erosive cropland than owner-operators.

Hypothesis 2—Renters use cropland for the production of relatively more erosive crops than owner-operators.

Hypothesis 3—With cropland and crop erosivity equal, renters use relatively fewer soil-conserving management practices than owner-operators.

Renters may be situated on land with a relatively high physical susceptibility to rainfall erosion (hypothesis 1). This would mean that a renter could generate more soil loss each year than an owner-operator with similar crop enterprises while expending the same amount of conservation effort in the form of reduced tillage, crop rotations, conservation practices, and the like. Conversely, rented land would require less conservation treatment or support more intensive production of soil-depleting crops if it were less vulnerable to rainfall erosion than land used by owner-operators. Interestingly enough, the physical properties of land—its erosion potential—as it relates to the pattern of landownership has not heretofore been studied in depth (14). The Missouri study of 120 farms, mentioned above, showed that rented cropland parcels had ^{lower} higher erosion potential than owner-operated ones (9). But there is no *a priori* basis for predicting whether this relationship holds at the national level.

Renters may produce relatively more erosive crops (hypothesis 2). If so, soil loss is expected to be higher on land with similar physical erosion potential and similar conservation support practices. On balance, the literature tends to support the hypothesis that farm rental affects crop enterprise selection. As noted earlier, USDA evaluations of cropland soil erosion during the thirties stressed that disproportionate numbers of tenant farmers produced soil-depleting crops (21). Farm tenancy is less important today, but leasing by part-owners increasingly involves a cash lease rather than a crop-share lease (3, 25). While decisions on crop enter-

prise are dictated by the larger economic environment, one might infer from this trend that rental agreements often involve a shorter planning horizon or less tenure security for the renter (3). If true, production of soil-conserving sod crops may be increasingly disadvantageous on rented land because the initial costs of establishing a sod crop must be amortized over several years to make the crop economic. For example, a Pennsylvania case study found that commercial dairy farmers tend to grow hay crops on land they own and grow corn silage, an erosive crop, on land they rent from others (24).

Finally, renters using land of similar quality and producing similar crops may generate more soil loss than owner-operators because they use fewer soil-conserving management practices (hypothesis 3). These practices, reflected in CP, include crop rotation, tillage practices, use of crop residues, and installation of various conservation support practices (such as terraces or contour farming). The presence of such management differences, after controlling for the land's erosion potential and the presence or absence of an erosive crop, ought to allow one to focus on the rental-conservation effort issue and test the longstanding proposition that separation of ownership from control materially affects conservation management on cropland.

Cropland Erosion and Land Tenure

About 413 million acres of privately owned land are used for crop production in the United States. Gross erosion is more than 1.9 billion tons each year (20). For the NRI cropland data used here, soil erosion from rainfall averages 4.95 tons per acre per year (table 3). Soil loss is 4.7 tons per acre per year on owned-operated land and about 5.3 tons on rented land. This small difference, 0.6 ton on average, does not contradict the results of Lee's comprehensive analysis which found only small differences in soil loss rates among tenure groups (13).

Table 3—Average annual soil loss for owner-operated and rented cropland sample points, United States, 1977

Land tenure	Sample points	Average soil loss
	<i>Number</i>	<i>Tons/acre/year</i>
Owner	6,149	4.70
Renter	3,784	5.33
Total ¹	9,933	4.95

¹Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

However, U.S. cropland varies greatly in its physical susceptibility to erosion from rainfall. The variation is due to climate, topography, and parent material in the soil. About 36 percent of all cropland is nonerosive (table 4)—that is, erodes at less than 5 tons per acre per year regardless of management applied. At the other extreme, roughly 9 percent is highly erosive and requires permanent vegetative cover to achieve a 5-ton tolerance. The remainder is moderately erosive because it will erode above or below tolerance depending upon decisions made by the operator on crops grown and support practices used.⁴

In contrast to limited case study results (9), these physical parameters governing soil loss bear no statistical relationship to tenure of operator. Thus, the hypothesis that renters are situated on inferior land when compared with owners who operate their own land is rejected. The distribution of land among erosion

⁴These results compare favorably with estimates for all U.S. cropland, regardless of owner identity, reported elsewhere. For all U.S. cropland, the percentages of nonerosive, moderately erosive, and highly erosive cropland were 37, 55, and 8 percent, respectively (4).

Table 4—Distribution of owner-operated and rented cropland sample points by cropland erosion class, United States, 1977

Cropland erosion class ¹	Total	Owner	Renter
<i>Number of sample points</i>			
Nonerosive	3,590	2,257	1,333
Moderately erosive	5,476	3,362	2,114
Highly erosive	867	530	337
Total	9,933	6,149	3,784
<i>Percent</i>			
Nonerosive	36.1	36.7	35.2
Moderately erosive	55.1	54.6	55.7
Highly erosive	8.7	8.6	8.9
Total ²	100.0	100.0	100.0
$\chi^2 = 2.24^*$			

* $\chi^2_{95,2df} = 5.99$.

¹Nonerosive cropland will not erode at a rate greater than 5 tons per acre per year regardless of management applied; moderately erosive cropland will erode above or below 5 tons depending on management applied; highly erosive cropland will not erode at or below the 5-ton rate except under the most restricted rotations and conservation support practices (4).

²Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

classes is virtually identical for renters and owner-operators.

Crop selection on rented land does tend to be skewed toward more erosive crops. Almost two-thirds of all rented land was planted to an erosive row crop; about a quarter was planted to a highly erosive row crop. Nationally, a little more than half of all cropland was planted to an erosive row crop during the 1977 crop year (table 5); slightly more than a fifth was used for hay, pasture, or was classified as cropland other than row crops or close-grown crops. More than a quarter of all owner-operated cropland was used for the least erosive sod or cover crops. Half of all cropland used by an owner was in a close-grown or sod crop use during the 1977 crop year. Only a fifth of owner-operated cropland was planted to a highly erosive crop. Thus, the second hypothesis cannot be rejected.

Relationships between landownership, cropland erosion potential, and crop erosivity provide a basis for examining differences in conservation management on rented land. The sample points were first arrayed in reference to a 5-ton-per-acre-per-year soil loss tolerance so ero-

Table 5—Distribution of owner-operated and rented cropland sample points by erosiveness of crop grown, United States, 1977

Crop erosivity ¹	Total	Owner	Renter
<i>Number of sample points</i>			
Least erosive	2,080	1,601	479
Less erosive	2,359	1,446	913
Moderately erosive	3,257	1,906	1,351
Highly erosive	2,237	1,196	1,041
Total	9,933	6,149	3,784
<i>Percent</i>			
Least erosive	20.9	26.0	12.7
Less erosive	23.8	23.5	24.1
Moderately erosive	32.8	31.0	35.7
Highly erosive	22.5	19.5	27.5
Total ²	100.0	100.0	100.0
$\chi^2 = 274.92^*$			

* $\chi^2_{95, 3df} = 7.82$.

¹Least erosive: Rotation hay and pasture, improved hayland, native hay, and other cropland.

Less erosive: Wheat, barley, oats, rice, and other close-grown crops.

Moderately erosive: Corn, grain sorghum, other row crops.

Highly erosive: Soybeans, cotton, peanuts, tobacco, sugar beets, potatoes, and vegetables.

²Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

sion could be compared on rented and owner-operated cropland (table 6). A significantly higher proportion of rented land than owner-operated land eroded above tolerance during the 1977 crop year, but the difference is small. For the Nation, about 74 percent of rented cropland eroded at 5 tons per acre per year or less; roughly 78 percent of cropland operated by an owner eroded within that limit.

Of course, one expects wide differences in annual soil loss, depending upon the erosiveness of the crop grown and the erosion potential of land allocated to each crop. These differences are clearly demonstrated by computing the average annual soil loss by type of crop and type of cropland (fig. 2). On average, about 5 tons of soil are lost annually from each crop acre; the loss approaches 8 tons for the most erosive crops. When grown on the Nation's most erosive cropland, these highly erosive crops generate 37 tons of soil loss per acre per year. At the other extreme, soil loss rates by type of crop range from 0.2 to 1.4 tons per acre per year on nonerosive cropland.

The possibility that different erosion rates trace to differences in land management by owners and renters was tested by comparing mean values of CP, the management component of the Universal Soil Loss Equation, for each crop type and for cropland rated as moderately or highly erosive. If differences in CP are statistically significant, after controlling for crop grown and cropland erosion potential, one can make an in-

Table 6—Distribution of owner-operated and rented cropland sample points by level of conservation management, United States, 1977

Rate of erosion	Total	Owner	Renter
<i>Number of sample points</i>			
≤ 5 TAY ¹	7,546	4,765	2,781
> 5 TAY	2,387	1,384	1,003
Total	9,933	6,149	3,784
<i>Percent</i>			
≤ 5 TAY	76.0	77.5	73.5
> 5 TAY	24.0	22.5	26.5
Total ²	100.0	100.0	100.0
$\chi^2 = 18.42^*$			

* $\chi^2_{95, 1df} = 3.84$.

¹TAY = tons per acre per year.

²Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

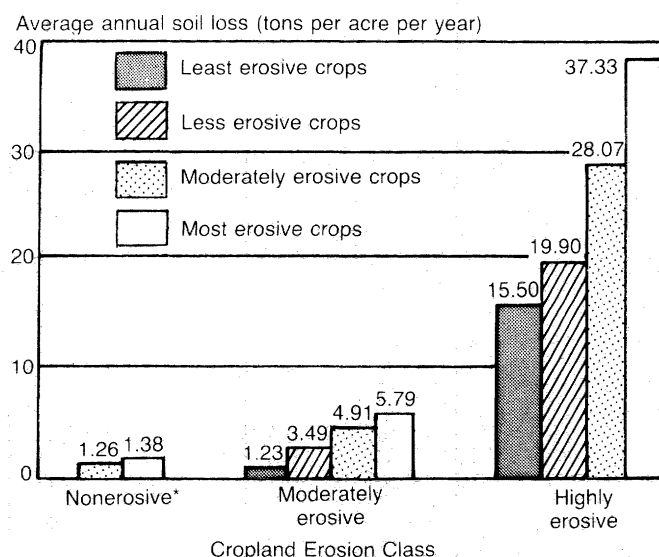
ference about landownership and conservation effort on land that is susceptible to excessive erosion.

Crop and practice factors (CP) for both moderately erosive cropland (table 7) and highly erosive cropland (table 8), are roughly comparable, on average, for owner-operated and rented land. Although rented cropland usually has a higher average CP—reflecting less soil-conserving management—the differences in sample means are not statistically significant. This is due to substantial amounts of variance around the average for both owner-operators and renters.

Coefficients of variation, measuring variance as a percentage of the sample mean, ranged from 36 to more than 140 percent depending on crop erosivity on moderately erosive cropland with annual soil loss above 5 tons per acre during the 1977 crop year (table 7). Variation ranging up to 90 percent of a sample mean is found on highly erosive cropland (table 8).

Variations of this magnitude imply, as one might expect, that soil loss outcomes are highly variable depending on management practices used by farm operators. The data, however, do not show that variability in manage-

Figure 2. Average annual soil loss by crop erosivity and cropland erosion class, United States, 1977



*Least erosive and less erosive crops cause less than 1 ton per acre per year of soil loss.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

Table 7—Moderately erosive U.S. cropland: Average CP¹ (crop and practice factor) by erosiveness of crop grown and type of farm operator, 1977

Crop erosivity ²	Owner	Renter
<i>Average CP</i>		
Least erosive	0.04 (142) ³	0.05 (143)
Less erosive	.20 (57)	.21 (47)
Moderately erosive	.27 (52)	.30 (44)
Most erosive	.32 (39)	.33 (36)
All crops ⁴	.21 (74)	.26 (57)

¹CP is the management component of the Universal Soil Loss Equation (USLE) = RKLSCP, measuring gross annual soil loss in tons per acre per year.

²Least erosive: Rotation hay and pasture, improved hayland, native hay, and other cropland.
Less erosive: Wheat, barley, oats, rice, and other close-grown crops.

Moderately erosive: Corn, grain sorghum, other row crops.
Highly erosive: Soybeans, cotton, peanuts, tobacco, sugar beets, potatoes, and vegetables.

³Numbers in parentheses are coefficients of variation, expressing standard deviation from the mean as a percentage of the sample mean.

⁴Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

Table 8—Highly erosive U.S. cropland: Average CP¹ (crop and practice factor) by erosiveness of crop grown and type of farm operator, 1977

Crop erosivity ²	Owner	Renter
<i>Average CP</i>		
Least erosive	0.11 (90) ³	0.12 (81)
Less erosive	.17 (50)	.22 (46)
Moderately erosive	.23 (52)	.26 (49)
Most erosive	.31 (44)	.30 (39)
All crops ⁴	.22 (61)	.25 (52)

¹CP is the management component of the Universal Soil Loss Equation (USLE) = RKLSCP, measuring gross annual soil loss in tons per acre per year.

²Least erosive: Rotation hay and pasture, improved hayland, native hay, and other cropland.
Less erosive: Wheat, barley, oats, rice, and other close-grown crops.

Moderately erosive: Corn, grain sorghum, other row crops.
Highly erosive: Soybeans, cotton, peanuts, tobacco, sugar beets, potatoes, and vegetables.

³Numbers in parentheses are coefficients of variation, expressing standard deviation from the mean as a percentage of the sample mean.

⁴Excludes Alaska.

Source: 1977 National Resource Inventory and 1978 Landownership Survey.

ment is any greater on rented land than it is on owner-operated land. Thus, the third hypothesis is also rejected.

Taken together, the analysis of crop and practice (CP) factors, after taking erosion potential of the land and erosiveness of crop grown into account, does not support the hypothesis that farm operators give rented cropland less conservation treatment or inferior conservation treatment compared with land that they own. Despite its intuitive appeal, the idea cannot be substantiated with up-to-date national data on cropland management.

Implications

Soil loss due to rainfall erosion from cropland is widely viewed as a major public policy issue in the United States. The search for remedial public programs will most likely intensify at the Federal level in the near future as the Congress takes new farm legislation under consideration in 1985. This study was directed toward the role that farm tenancy might play in these deliberations; the study grew out of a popular but poorly documented argument that land rental increases soil erosion from cropland. Much literature on the subject lacks focus and tends to confuse conservation effort with the physical characteristics of land used for crops and the types of crops planted (the latter being dictated by supply and demand conditions in national and international markets for farm commodities).

After arranging national data to take account of the erosion potential of cropland and the erosiveness of crops produced, I found no statistically significant differences in conservation management between rented cropland and owner-operated cropland. While renters' management may be substandard in some local situations, this analysis suggests that fears about a general trend toward excessive soil erosion due to substandard conservation effort on rented land are not justified. Instead, the Nation experiences excessive cropland erosion because:

- Some highly erosive land is used for crop production.
- The mix of crops produced in the United States is tilted toward highly erosive crops.

Farm operators, whether using rented land or land they own, are caught up in these broad features of American agriculture.

A number of factors probably underlie the finding that conservation management does not materially differ on rented farmland. A key factor is that some important soil-conserving management practices are neutral with regard to tenure because they are cost effective in their own right. Use of reduced tillage, for example, is generally thought to be uninfluenced by tenure (14). Energy and labor savings can be realized when tillage operations are reduced. Unlike a soil-conserving improvement to land (such as a terrace), tillage practices and tillage equipment can be altered on rented land without overt action on the part of a landlord (15).

Aside from tenure-neutral tillage practices, cost-effective cultural practices often dictate a crop rotation involving a less erosive crop. For example, farmers often find it economical to rotate corn—an erosive crop—with a less erosive small grain or sod crop to control pests that diminish corn yields. Rotating crops to sustain the yield of erosive crops can have a favorable, but somewhat inadvertent, effect on soil loss from rainfall erosion. Like reduced tillage practices, soil-conserving rotations devised to sustain yields of erosive crops are probably neutral to tenure.

Also, the most prevalent conservation practice used on U.S. cropland is "residue management" (4). With this practice, debris from harvested row or close-grown crops is left on the land. The effect is to reduce soil loss, but the cause of such action is not always clear. While many farmers probably leave crop residues in the field to minimize runoff from rainfall, the crop debris may also be left on the land because it has no economic value. That is, its value in an alternate use is less than the cost incurred in removing it. Again, this makes soil conservation somewhat inadvertent but, more important, also makes it neutral with regard to tenure. If removing crop residue is not economical on owned land, it is unlikely to be economical on rented land.

One can also speculate that management of rented land is not materially worse than on owner-operated land due to factors other than the biologic-economic considerations involved with crop production. Farmers may be as concerned about erosion on land they rent as they are on land they own. Studies dealing with farmer attitudes toward conservation are generally too crude in design to focus with precision on the issue of owned versus rented land. The physical circumstances—cropland erosivity, crop mix, and the like—affecting a farm operator must be known before the operator's views toward soil conservation can be placed in context and accurately interpreted.

Some farmers may also have longer term ownership motives when they make decisions on the management of rented land. A majority of all farmers acquire their farmland via purchase in the land market (7, 22). Furthermore, the farm real estate market may be dominated by expansion buyers who use the purchase to expand an existing farm business (8). One might presume that rental precedes purchase in a good number of cases. Why would a farmer undertake abusive farming practices today on land that one day may be his (her) own?

Regardless of the treatment of rented land by farm operators, a clear implication of this study is that continued (if not increasing) dependence on rented land in the United States may exacerbate the Nation's soil loss

problem. Proportionally more rented land is used for the production of erosive row crops—63 percent of all rented land compared with 56 percent of owner-operated land. If that trend persists or accelerates, rented cropland will make progressively larger contributions to the Nation's soil erosion problem in the future.

However, this finding provides a distinctly different focus for public policy from that which would be afforded by confirmation of the conservation management/-rented land hypothesis. This research suggests that new stress must be placed on the structure and performance of the rental market for farmland. Arrangements fashioned between landlord and tenant often involve production of a row crop. With current technology, these crops lead to high rates of soil loss when grown on land that is vulnerable to rainfall erosion.

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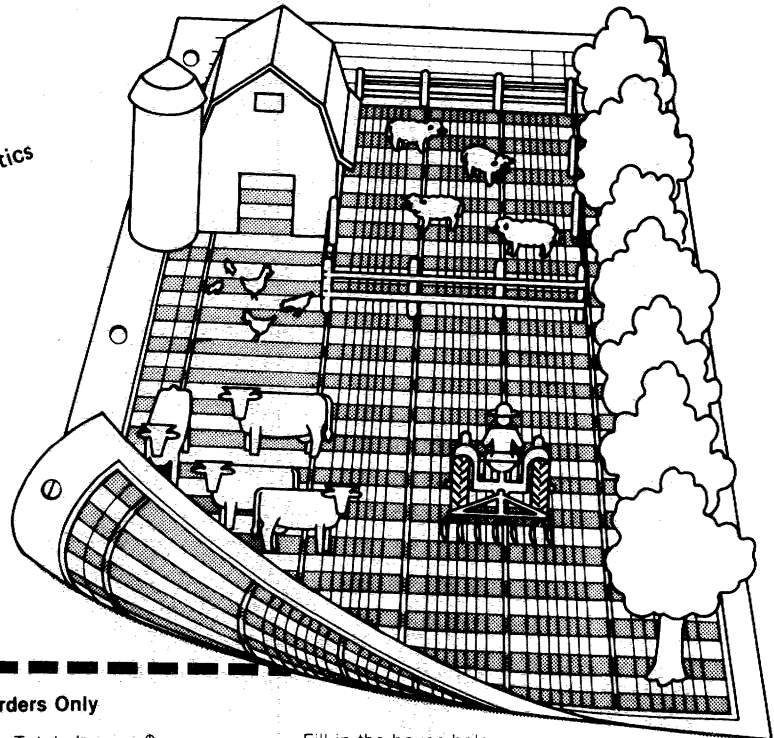
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